BIOTIC COMMUNITIES

Sample Site Selection

Thirty-one sites in the Fox River basin were selected for habitat and biological assessment during the summer of 1987 (Figure fs). Due to drought conditions, only 19 sites were sampled (Table 7, contact authors for Table 7 information).

Fisheries Evaluation Methods

Nearly three miles of Fox River and its tributaries were sampled during summer 1987. The minimum sample area per station was one pool and two riffles, runs or glide habitats. Usually, three pools and three riffles, runs or glides were considered to be adequate. Fish were collected primarily by seine measuring 25'x6'x1/8" mesh. Riffles were sampled using kick seine methods. Pools were usually surveyed in a downstream direction. The number of seine hauls varied, but usually consecutive hauls were made until the number of fish captured approached zero or were substantially fewer than in preceding hauls. Large, deep pools were "walked" downstream with one person stationary near the bank and the other sweeping 180 degrees around the pivot. Where possible, a boat mounted direct current electrofishing rig was used to sample deep pools. Large fishes were weighed, measured and returned to the water on site. Spines or scales were taken from selected species for age analysis. Small fishes were preserved on site with 10% formaline and later identified and enumerated in the laboratory. Voucher specimens were deposited at the University of Nebraska State Museum. Analyses of fish community data followed Pflieger (1971) for geographical affinity and Pflieger (1989) for ecological affinity within Missouri. Trophic guild assignments followed Karr, et. al. (1986) and were occasionally amended at the discretion of the investigator in order to reflect knowledge of local fish ecology.

Fishery Evaluation

A total of 52 species of fishes are known to the Fox River basin in Missouri, representing 14 families (Table 9). The 1987 survey yielded 19,582 fish, 47 species and one hybrid, adding 16 species to the annotated list. Five species recorded from the basin prior to 1987 were not collected. In general, the number of species collected per station increased with an increase in stream order (Figure 12, contact authors for Figure 12 information).

In general, the Fox River basin was dominated by ubiquitous, wide ranging or large river species. As classified by Pflieger (1971), wide ranging types accounted 35% of all species collected. Other faunal groups were almost evenly represented; prairie species accounted for `8%, while the river, lowland, and Ozark-prairie faunal groups each contributed 14% to the total. Ozark species (four) comprised 8% of all species known to the basin.

Dominant fish families were minnow (Cyprinidae-15 species), sucker (Catostomidae-8 species), catfish (Ictaluridae-7 species), sunfish (Centrarchidae-7 species) and perch (percidae-5 species).

The most collected fish was the omnivorous red shiner which comprised 31% of the total sample and occurred at 95% of the 1987 sample sites (Table 10). The bluntnose minnow, also an omnivore, was the second-most sampled fish, totaling 23% of all collected specimens and occurring at 84% of the sample sites. Other frequently sampled species include the central stoneroller, channel catfish, mosquitofish, green sunfish, and johnny darter. All of these species occurred in at least 60% of the collection sites.

Species associated in the Fox River basin seemed to be limited to physicochemical parameters—often the case in prairie stream systems (Matthews 1988). The typical headwater species in this basin were tolerant types able to withstand environmental extremes. This typifies mid- and southern-plains streams, which differ from the northern plains where species associated in headwaters, due to more stable groundwater flow, consist of more intolerant types (Matthews 1988, Hrabik 1989). Common headwater species in the Fox River basin were the golden shiner, flathead minnow, creek chub, white sucker, black bullhead, green sunfish and johnny darter. These fish are insectivorous and omnivorous generalists.

Creek and small river habitats (e.g. Honey Creek, Little Fox River and the upper Fox River) support a richer fish fauna than the headwaters. The most common species were the central stoneroller, red shiner, bigmouth shiner, sand shiner, suckermouth minnow, bluntnose minnow, quillback, shorthead redhorse, channel catfish, mosquitofish, orangespotted sunfish, smallmouth bass and slenderhead darter. This species association consists of more specialized foragers and predators. Conspicuously absent from this assemblage, however, was the redfin shiner (*Notropis umbratilis*). This fish is widespread over most of northeastern Missouri (Pflieger 1975) and is dominant in some drainages (Hrabik, unpublished data). Its absence from Fox River, despite suitable habitat, poses an interesting zoogeographic question concerning the distribution of fishes in northeastern Missouri.

Fishes occurring in the lower Fox River were primarily specialized insectivores and predators. They included gar, common carp, silver chub, emerald shiner, river carpsucker, buffalo, flathead catfish, channel catfish, white bass, white crappie, sauger, walleye and freshwater drum.

The fishes of the Fox River basin can be characterized as widespread, tolerant, prairie-Ozark types. However, four species in the basin have been identified by Karr et.al. (1986) to be intolerant types. They are the Mississippi silvery minnow, slender madtom, tadpole madtom, and slenderhead darter.

The slender madtom, an Ozark species, has particular habitat and water quality requirements, and would be a good indicator of environmental perturbation. However, its preferred habitat is limited in the basin, making it too uncommon a resident of Fox River to serve as a water quality indicator.

The slenderhead darter was surprisingly abundant in the basin, reaching its greatest diversity in the middle section of Fox River. The upper Mississippi River drainage seems to be a stronghold for this species in Missouri (Pflieger, personal communication). Its habitat requirements and distribution abroad (Lee et.al. 1980) suggest a preference for clear, cool water. However, it was more widespread than the slender madtom in the Fox River basin and seemed to tolerate moderate sedimentation.

The tadpole madtom is an insectivore found in small, sluggist streams reach in organic debris. It seems tolerant of high turbidity and silt, particularly in the western plains (Hrabik, unpublished data). In northeastern Missouri, tadpole madtoms are found in low gradient, murky streams, some of which have been channelized (Hrabik, unpublished data). For these reasons, it is not considered to be an intolerant species in the Fox River basin.

The Mississippi silvery minnow has abruptly declined in the pooled portion of the Mississippi River (Pflieger 1975, Grace and Pflieger 1985) and was last collected from Fox River in 1941. Similar declines have occurred elsewhere in its range particularly in Tennessee (Etnier 1979). Apparently, free flowing water is required for certain aspects of its life history, but reasons for its decline are not understood. The Mississippi silvery minnow has been recommended for listing as a Watch List species in Missouri because of its probable extirpation in northeastern Missouri streams, including the upper Mississippi River.

The only other species that may have inhabited the upper Fox River basin in Missouri was the Topeka shiner, *Notropis tristis* (formerly *N. topeka*). It was collected in Fox River in Iowa prior to 1948 and more recently in tributaries to the lower Des Moines River in Lee County, Iowa (adjacent to Clark County, Missouri) and in Cedar Creek, Clark County (Harlan and Speaker 1987, Hrabik, unpublished data). Its former distribution may have included other tributaries to the Des Moines River in Iowa and Missouri as well as the upper Fox and Wyaconda Rivers to the Chariton River basin, where it may still be found (Pflieger 1975).

Other unusual or rare species collected in the basin were northern pike, golden redhorse, orangethroat darter, warmouth, black buffalo and central mudminnow. No attempt was made to sample mudminnows in basin wetlands during the 1987 survey.

Northern pike were collected in lower Honey Creek near the confluence of Fox River. Apparently, a self-sustaining, low density population inhabits the Alluvial Plain as occasional reports of pike have come from the area. Pike have been sampled in Mississippi River floodplain ditches when flooded (Gordon Farabee, personal communication). Pike are sometimes captured as far south as Salt River in northeastern Missouri (Hrabik, unpublished data). They are currently under consideration for listing as rare in Missouri.

Golden redhorse and orangethroat darters are Ozark species in Missouri. We collected only one golden redhorse in the basin (Honey Creek). Orangethroat darters exhibited a wider but habitat-specific distribution. Before these collections, orangethroat darters were not known to occur north of the North River basin in Marion County. Subsequent surveys (Hrabik, unpublished data) have documented its occurrence in all major tributaries to the upper Mississippi River in northeastern Missouri.

Warmouth and black buffalo are peripheral to the basin. One warmouth was sampled in Fox River near the confluence of the Mississippi River in 1987. Warmouth are taken occasionally by anglers in the upper Mississippi River but are most abundant in the Bootheel area in Missouri. Although black buffalo are widespread in Missouri, they are rare in the upper Mississippi River where its frequency of

occurrence declines south to north. One black buffalo was sampled from Fox River in 1941.

Mosquitofish and quillback were not collected by previous investigators, but they were widespread and abundant in 1987. Mosquitofish were not known to northeastern Missouri 15 years ago (Pflieger 1975). Today, this species is found in every major basin in northeastern Missouri (Hrabik, unpublished data). Similar range extensions have occurred in other Midwestern plains streams particularly after introduction (Brow 1987, Lynch 1988). The ecological consequences of introducing this species, and its rapid rate of colonization, are being argued by ecologists. In the Fox River basin and elsewhere in northeastern Missouri, mosquitofish seem to thrive in disturbed areas but are generally excluded in better quality streams (Hrabik, unpublished data).

Quillback were the most frequently collected sucker in the Fox River basin. This fish has probably always been abundant and widespread in the basin and may have been overlooked or misidentified by previous researchers.

Game fishes were well represented in the basin. Most intriguing, however, were the 116 smallmouth bass sampled in the middle section of Fox River. Similar to quillback, smallmouth bass were not recorded from Fox River prior to 1987. Smallmouth bass size structure was poor; the largest individual measured 8.9 inches (age-1+). Young-of-the-year averaged 4.6 inches (N=56) in August. Pflieger (1975) reported age-1 smallmouth bass at 3.5 inches from Ozark populations. The lack of older and larger smallmouth bass was puzzling. Apparently, reproductive habitat is available in the middle portion of Fox River but the fish move out as yearlings, presumably to the Mississippi River. If so, this eliminates smallmouth bass from consideration as the keystone predator in the system.

Channel catfish are the most important game species in the basin. They were collected at 63% of all sample sites and constituted 2.7% of all fishes collected. Substock size fish (<11 inches) dominated the sample, accounting for 84% of the 540 channel catfish captured in 1987 (Figure 13). Although sampling gear may have skewed the length frequency histogram somewhat towards smaller fish, the representation of size structure seems accurate for a mid-summer sample.

While the Fox River contained a high number of small channel catfish, its importance as a nursery area for the Mississippi River channel catfish population is unknown. In general, the relationship between channel catfish stocks in the Mississippi River and its tributaries is not well understood. For example, the Fox River channel catfish population is dominated by small fish in mid-summer, even in habitats which seem suitable for large fish. A pressing question is whether this is a static characteristic, or whether seasonal movements of adult channel catfish to and from the Mississippi River are so dramatic that catfish size structure in Fox River and other tributaries is strongly seasonal.

Mean length of 164 channel catfish ages 1-7 were 2.0, 4.8, 7.3, 9.7, 12.1, 14.2 and 16.9 inches, respectively (Table 11). T his age structure seems consistent with that reported for another northeastern Missouri stream (Purkett 1958).

Only 28 flathead catfish were captured during the 1987 survey, 14 of which were marked with Floy anchor tags and released; there have been no returns. The low number of flathead catfish captured is probably not indicative of its true density in Fox River. Distribution and size structure may be better described by using multiple collection methods at various times of year. A few anglers report good catches of flathead catfish each year from the Kahoka Hills region.

Twenty-four flathead catfish were aged (Table 11). Mean length at age 4 was 10.1 inches in Fox River compared to 11.8 inches in Salt River (Purkett 1958). However, the small Fox River sample was inadequate to describe flathead catfish age structure. Fox River may function as a nursery area for the Mississippi River flathead catfish population. It is quite possible among the fish we aged that some of their growth occurred in the Mississippi.

White crappie were usually present in small numbers in pool habitats with cover. However, numerous white crappie from the Mississippi River utilize lower Fox River at various times—often a high proportion of 10-inch and larger fish. Fifty white crappie were collected during the 1987 survey; 82% were 9 inches long. Age 1-4 white crappie averaged 3.9, 8.2, 10.3, and 11.8 inches, respectively, suggesting rapid growth.

Aquatic Invertebrates

No detailed surveys of aquatic invertebrates, including freshwater mussels or clams, have been conducted in the Fox River basin to date. Although invertebrate sampling was beyond the scope of the 1987 survey, mussels encountered inadvertently were noted (Table 12).

The winged mapleleaf, *Quadrula frigosa*, is a candidate for Federal protection. Three specimens were collected by Charles Nelson in Fox River at T65N, R6W, Clark County, probably in the 1920s or 1930s (Dr. David H. Stansberry, Ohio State University, personal communication). This is the only known collection of this species in Missouri. The winged mapleleaf superficially resembles the mapleleaf (*Q. quadrula*), and may have easily been overlooked in 1987 if it still existed.

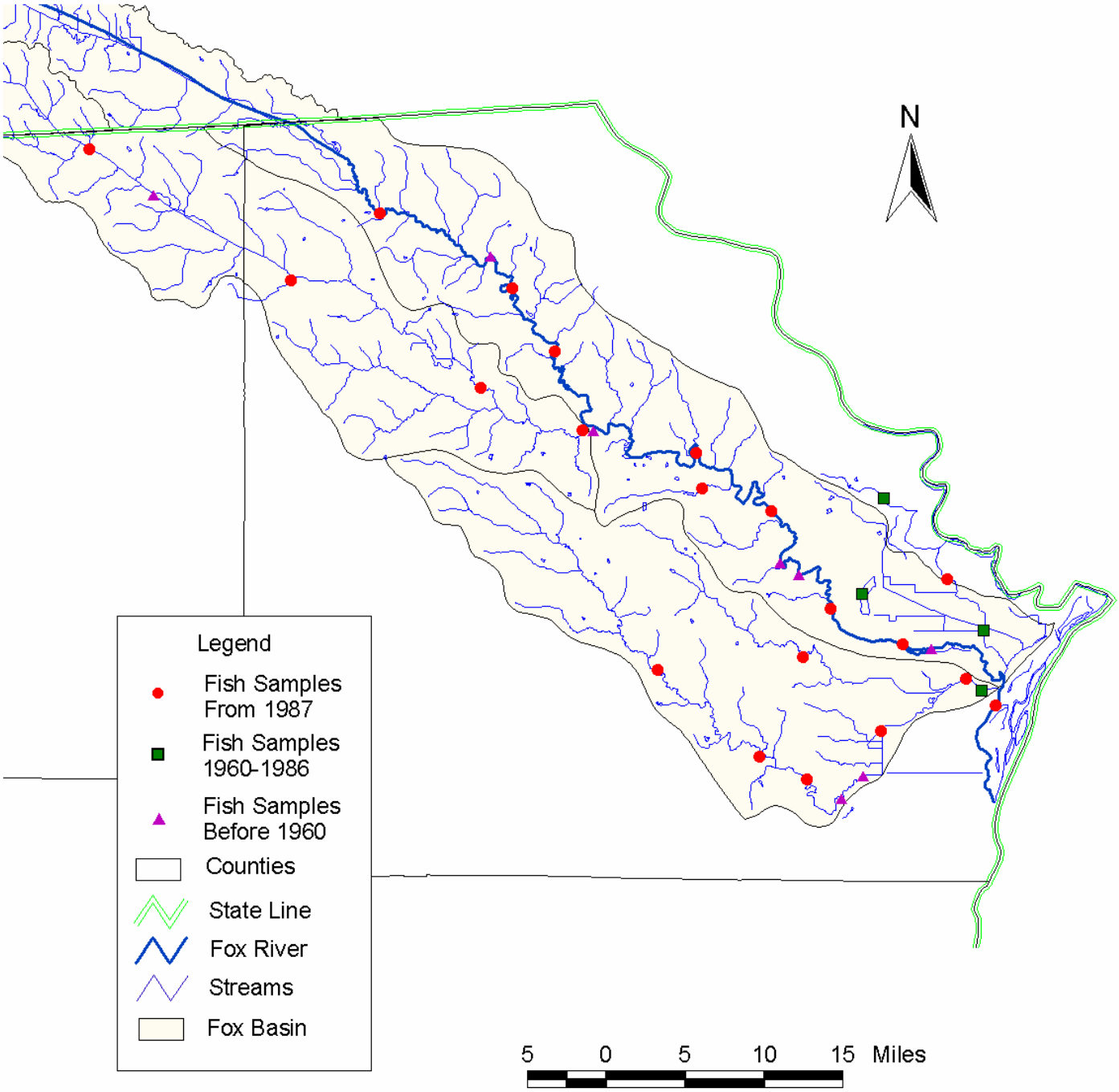

Figure fs. Fish sample locations in the Fox River Basin, in Missouri.

Table 7. Stream Habitat and Fish Sample Sites in the Fox River Basin, 1987.

Stream Code/Name	Site	Order	River Mile	Location Township-Range-Section	Topographic Map	Survey Date
37521000 - Little Fox River	1	3	22.9	67N-10W-19	Azen	08-12
37521000 - Little Fox River	2	3	14.6	66N-09W-08	Mount Sterling	08-12
37521000 - Little Fox River	4	4	3.7	65N-08W-04	Medill	08-17
37521000 - Little Fox River	8	4	0.0	65N-08W-22	Kahoka	08-18
37500000 - Fox River	10	4	44.0	66N-08W-06	Anson	08-19
37500000 - Fox River	11	4	38.7	66N-08W-16	Anson	08-19
37500000 - Fox River	12	4	35.0	66N-08W-27	Medill	08-20
37500000 - Fox River	16	5	24.6	65N-07W-09	Kahoka	08-20
37514000 - Brush Creek	17	2	1.4	65N-07W-16	Kahoka	08-26
37500000 - Fox River	19	5	19.2	65N-07W-23	Kahoka	08-26
37500000 - Fox River	20	5	10.6	64N-06W-19	Kahoka S.E.	09-01
37500000 - Fox River	22	5	4.0	64N-06W-18	Warsaw	09-02
37512000 - Hemp Slough	23	-	4.8	65N-06W-35	Wayland	09-01
37511100 - Sugar Creek	26	3	4.6	64N-06W-07	Kahoka S.E.	08-06
37511000 - Honey Creek	27	3	21.6	64N-07W-17	St. Patrick	0804
37511000 - Honey Creek	28	3	14.1	64N-07W-26	St. Patrick	08-04
37511000 - Honey Creek	29	3	12.3	64N-07W-36	Kahoka S.E.	08-05
37511000 - Honey Creek	30	3	5.8	64N-06W-28	Kahoka S.E.	08-06
37511000 - Honey Creek	31	4	1.8	64N-06W-14	Kahoka S.E.	08-05

Table 9. Annotated List and Status of Fishes Known to the Fox River Basin, Including Trophic, Geographical, and Ecological Affinities.

Species	Coll. 1987 Survey	Coll. Prior Surveys	Trophic[1] Guild	Status[2]	Geographic[3] Affinity	Ecological[4] Affinity
Longnose Gar (*Lepisosteus osseus*)	X		P	LA	W	L-LR
Shortnose Gar (*Lepisosteus platostomus*)	X		P	LA	R	L-LR
Bowfin (*Amia calva*)	X	X	P	U	L	L-LR
Goldeye (*Hiodon alosoides*)	X		P	U	W	L-LR
Gizzard Shad (*Dorosoma cepedianum*)	X	X	O	LA	W	L-LR,LA
Central Stoneroller (*Campostoma anomalum*)	X	X	H	C	O-P	N-CR
Red Shiner (*Cyprinella lutrensis*)	X	X	O	C	P	N-CR,SR
Common Carp (*Cyprinus carpio*)	X	X	O	C	W	L-SR, LR
Mississippi Silvery Minnow (*Hyboqnathus nuchalis*)		X	H*	E	L	N-LR
Silver Chub (*Hybopsis storeriana*)	X	X	I	LA	R	N-LR
Golden Shiner (*Notemiqonus crysoleucas*)	X	X	O	LA	W	N-HS
Emerald Shiner (*Notropis atherinoides*)	X	X	I	LA	R	N-LR
River Shiner (*Notropis blennius*)	X		I	U	R	N-LR
Bigmouth Shiner (*Notropis dorsalis*)	X	X	I	C	P	N-CR
Sand Shiner (Notropis ludibundus)	X	X	O	C	P	N-CR,SR
Suckermouth Minnow (*Phenacobius mirabilis*)	X	X	I	C	P	B-SR,LR
Bluntnose Minnow (*Pimephales notatus*)	X	X	O	C	W	N-CR,SR
Flathead Minnow (*Pimephales promelad*)	X	X	O	LA	P	N-HS
Bullhead Minnow (*Pimephales viqilax*)	X	X	I	U	L	N-SR,LR
Creek Chub (*Semotilus atromaculatus*)	X	X	I	C	O-P	N-CR,HS
River Carpsucker (*Carpiodes carpio*)	X	X	O	C	P	L-SR,LR
Quillback (*Carpiodes cyprinus*)	X		O	C	P	L-SR
White Sucker (*Catostomus commersoni*)	X	X	I	LA	O-P	L-HS,SR
Smallmouth Buffalo (*Ictiobus bubalus*)	X		I	LA	W	L-LR
Bigmouth Buffalo (*Ictiobus cyprinellus*)	X		I\P	LA	W	L-LR
Black Buffalo (*Ictiobus nigeru*)		X	I	R	W	L-LR
Golden Redhorse (*Moxostoma erythrurum*)	X		I	R	O	L-SR,CR
Shorthead Redhorse (*Moxostoma macrolepidotum*)	X	X	I	C	O-P	L-SR
Black Bullhead (*Ameiurus melas*)	X	X	I	LA	W	L-CR,HS
Yellow Bullhead (*Ameiurus natalis*)	X	X	I	LA	W	L-CR,SR
Channel Catfish (*Ictalurus punctatus*)	X	X	I/P	C	W	L-SR,LR
Slender Madtom (*Noturus exilis*)	X		I*	U	O	B-SR
Tadpole Madtom (*Noturus gyrinus*)	X	X	I	U	O	B-CR
Freckled Madtom (*Noturus nocturnus*)		X	I	U	L	B-LR
Flathead Catfish (*Pylodictus olivaris*)	X	X	P	LA	W	L-SR,LR
Northern Pike (*Esox lucius*)	X		P	R	O-P	L-LR,LA
Central Mudminnow (*Umbra limi*)		X	O	R	P	N-LA
Mosquitofish (*Gambusia affinis*)	X	X	I	C	L	N-SR,LR
White Bass (*Morone chrysops*)	X		I/P	LA	R	L-LR
Green Sunfish (*Lepomis cyanellus*)	X	X	I/P	C	W	L-HS,SR
Warmouth (*Lepomis gulosus*)	X		I/P	R	L	L-LR
Orangespotted Sunfish (*Lepomis humilis*)	X	X	I	C	P	L-CR
Bluegill (*Lepomis macrochirus*)	X	X	I	LA	W	L-SR
Smallmouth Bass (*Micropterus dolomieui*)	X		I/P	C	O	L-SR
Largemouth Bass (*Micropterus salmoides*)	X	X	I/P	LA	W	L-SR
White Crappie (*Pomoxis annularis*)	X	X	I/P	LA	W	L-LR

Table 9 continued

Black Crappie (*Pomoxis nigromaculatus*)	X	X	I/P	LA	W	L-LR
Johnny Darter (*Etheostoma nigrum*)	X	X	I	C	O-P	B-HS,CR
Orangethroat Darter (*Etheostoma spectabile*)	X		I	U	O	B-HS,CR
Slenderhead Darter (*Percina phoxocephala*)	X	X	I*	C	O-P	B-SR,LR
Sauger (*Stizostedion canadense*)	X		P	LA	R	L-LR
Walleye (*Stizostedion vitreum*)		X	P	LA	W	L-LR
Freshwater Drum (*Aplodinotus grunniens*)	X		I/P	C	R	L-LR

[1] - H=Herbivore, I=Insectivore, O=Omnivore, P=Piscivore, *=Intolerant Species

[2] - C=Common, E=Extirpated, LA=Locally Abundant, R=Rare, U=Uncommon

[3] - L=Lowland, O=Ozark, P=Prairie, R=Big River, W=Wide Ranging

[4] - B=Benthic, L=Large Species, N=Nektonic, CR=Creek, HS=Headwater Stream, LA=Lake/Marsh, LR=Large River, SR=Small River

Table 10. Percentage Composition Within Sample Sites and Frequency of Occurrence Among All Sites of Fish Species Collected in the Fox River Basin, 1987 (*Denotes <0.5% Composition).

Species	1	2	4	8	10	11	12	16	17	19	20	22	23	26	27	28	29	30	31	Total % Comp	Total % Occr
Longnose Gar																			*	*	5
Shortnose Gar											`	*								*	5
Bowfin												*								*	5
Goldeye										*										*	5
Gizzard Shad											2	32						9	5	3	21
Central Stoneroller	1	*	*	*	*	*	*		5	*				10	1	11	9			2	68
Red Shiner	7	39	35	30	31	35	34	28	2	42	60	2		2	44	44	25	6	23	31	95
Common Carp					*			*				22	100					1	*	2	32
Silver Chub											*	*								*	11
Golden Shiner		*	*	*					3						2	*			2	*	37
Emerald Shiner				*								6							6	1	16
River Shiner												*								*	5
Bigmouth Shiner	70	17	9	17	10		4	*	2	*	1			39	3	5	6	1		10	79
Sand Shiner	1	12	6	2	2		2	3		2	1	*		6	3	2	5		*	2	79
Suckermouth Minnow	*	1		2	1		5	1	*		2	1		*	*	*	2		1	1	74
Bluntnose Minnow	2	11	20	13	31	38	46	45	18	37	14			7	17	22	38	1	14	23	84
Flathead Minnow	1	1	1	*			1	28			*				*				*	1	47
Bullhead MInnow											*									*	5
Creek Chub	12	3	1	3	1				18					13	4	2	1	1		2	58
River Carpsucker			1	2	5	*	1	4		1	4	2						1		1	53
Quillback	*	*	8	5	3	1	3	3		2	2	1		1	*	*	3	4	4	2	89
White Sucker	1	*	1	*			*		4					1	5	1	*	*		1	58
Smallmouth Buffalo												1							2	*	11
Bigmouth Buffalo												*							*	*	11
Golden Redhorse																			*	*	5
Shorthead Redhorse			1	2	1	2	1	1		*	1	*						*	*	1	58
Black				*	*		*		3			1			*	*	1	1	1	1	53

Table 10 continued

Bullhead																				
Yellow Bullhead		1				*			1						*		*	2		*	32
Channel Catfish			*	9	5	1	1	2		2	9	10				*		1	1	3	63
Slender Madtom						*				*						*				*	16
Tadpole Madtom																		*	*	*	11
Flathead Catfish					*	*		*		*	*	1								*	32
Northern Pike																			*	*	5
Mosquito-fish			*	9		1	1	1		1	2	1		2		2	8	55	16	3	68
White Bass												2							*	*	11
Green Sunfish		3	5	1	3	4	1	3	14	*	*	1		*	9	7	*	10		3	84
Warmouth												*								*	5
Orange-spotted Sunfish			*	*	*	*	1	2		1		9				*		1	1	1	58
Bluegill				*	*	*			1			2				*		1	10	*	42
Smallmouth Bass			1	2		1	1	2		2	*	*								1	42
Largemouth Bass				*								*			*			2	1	*	26
White Crappie			*	*	*	*		*				3							1	*	37
Black Crappie		*										1							1	*	16
Johnny Darter	3	7	7	2	5	4	3	2		*	*			15	10	3	2	1	1	3	84
Orange-throat Darter						*		*	*	*				2		1	*			*	37
Slenderhead Darter			1	*	1	8	*	3		6	*									1	42
Sauger												*								*	5
Freshwater Drum					*					*		2						3	5	*	26

Table 11. Age Structure of Channel and Flathead Catfish Collected from the Fox River Basin in 1987.

	Calculated Mean Length at Annulus						
	I	II	III	IV	V	VI	VII
Channel Catfish	2.0	4.8	7.3	9.7	12.1	14.2	16.9
Number Aged	44	14	19	50	18	4	15
Flathead Catfish	2.3	5.3	7.2	10.1	11.8	15.7	16.6
Number Aged	10	4	4	3	1	0	2

Table 12.Annotated List of Freshwater Mussels Sampled From the Fox River Basin in Missouri.

Giant floater	***Anodonta grandis grandis***
White heelsplitter	***Lasmigona complanata***
Fragile papershell	***Leptodea fragilis***
Pink heelsplitter	***Potamilus alatus***
Pink papershell	***Potamilus ohiensis***
Three ridge	***Amblema plicata plicata***
Fatmucket	***Lampsilis radiate***
Pondmussel	***Liqumia subrostrata***
Winged mapleleaf	***Quadrula frigosa***
Mapleleaf	***Quadrula quadrula***